

WHAT IS CLAIMED IS;

[1] A double tube type thermosyphon device in which an inner tube is disposed to be longitudinally passed through an outer tube disposed to be horizontally long, in which a working space defined between the outer tube and the inner tube is provided with an operating liquid and is hermetically closed, and in which heat exchange is performed between an outside and an inside of the outer tube while allowing a thermal source fluid to flow through the inner tube, the double tube type thermosyphon device wherein:

a large number of circumferentially formed narrow concave grooves are formed both in an inner wall surface of the outer tube facing the working space and in an outer wall surface of the inner tube facing the working space; and

the operating liquid is raised in a circumferential direction of the wall surface by capillary attraction via the narrow concave grooves, and is evaporated on an evaporating portion of either of the inner wall surface of the outer tube and the outer wall surface of the inner tube, /whereas the operating liquid is condensed on the other wall surface,/so that the outside of the outer tube is cooled or heated.

[2] The thermosyphon device of claim 1, wherein the narrow

concave groove has a groove width W_g shown in mathematical expression (1) as an allowable maximum groove width, and has a groove depth H_g shown in mathematical expression (2):

[Formula 1]

$$W_g \leq \frac{2\sigma \cos \theta \min}{\rho g D} \quad (1)$$

[Formula 2]

$$H_g \geq \frac{W_g}{2} \quad (2)$$

[3] The thermosyphon device of claim 1 or claim 2, characterized by being of an eccentric double tube type in which the inner tube has an axial center located at a position deviated from an axial center of the outer tube and in which the axial center of the inner tube is located below the axial center of the outer tube.

[4] A cooling and heating device that uses the thermosyphon device of any one of claims 1 to 3 and that performs switching between a cold fluid and a hot fluid serving as thermal source fluids, and cools and heats surroundings of the device as a single device.

[5] A double tube type thermosyphon device in which an inner

tube is disposed to be longitudinally passed through an outer tube disposed to be horizontally long, in which a working space defined between the outer tube and the inner tube is provided with an operating liquid and is hermetically closed, and in which heat exchange is performed between an outside and an inside of the outer tube while allowing a thermal source fluid to flow through the inner tube, the double tube type thermosyphon device wherein:

a large number of circumferentially formed narrow concave grooves are formed either in an inner wall surface of the outer tube facing the working space or in an outer wall surface of the inner tube facing the working space; and

the operating liquid is raised in a circumferential direction of the wall surface by capillary attraction via the narrow concave grooves, and is evaporated on an evaporating portion of either of the inner wall surface of the outer tube and the outer wall surface of the inner tube, whereas the operating liquid is condensed on the other wall surface, so that the outside of the outer tube is cooled or heated.

[6] A cooling and heating method using a double tube type thermosyphon in which an inner tube is disposed to be longitudinally passed through an outer tube disposed to be

horizontally long, in which a working space defined between the outer tube and the inner tube is provided with an operating liquid and is hermetically closed, and in which heat exchange is performed between an outside and an inside of the outer tube while allowing a thermal source fluid to flow through the inner tube, the double tube type thermosyphon wherein:

a large number of circumferentially formed narrow concave grooves are formed both in an inner wall surface of the outer tube facing the working space and in an outer wall surface of the inner tube facing the working space;

the operating liquid is always borne on the tube surfaces by capillary attraction via the narrow concave grooves; and

the outside of the outer tube is cooled or heated in accordance with the thermal source fluid while guiding the operating liquid upwardly and downwardly on the surface of each tube.

[7] A plant cultivating method carried out by burying the thermosyphon device of any one of claims 1 to 4 in plant cultivating soil.